

UTAH!

100 YEARS OF EXPLORATION



... and still the place to find oil and gas

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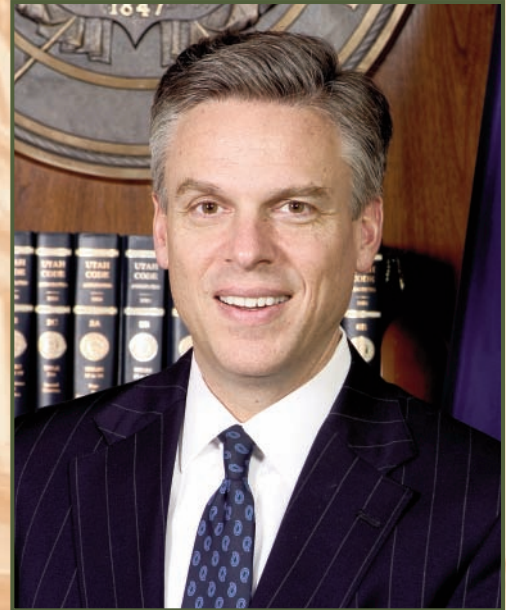
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Cover Photos: Top – Cane Creek anticline exposing the Permian Cutler and Pennsylvanian Honaker Trail Formations; view east from Dead Horse Point State Park. Middle – Midwest Exploration and Utah Southern No. 1 Shafer wildcat well drilled in 1924 targeting the Pennsylvanian Cane Creek shale of the Paradox Formation on the Cane Creek anticline; view southwest down the Colorado River. The well blew out and was abandoned. Used by permission, Utah State Historical Society, all rights reserved. Lower – Park Road oil field, about 6 miles west of Southern No. 1 Shafer wildcat well, produces from Cane Creek shale and discovered in 1991 using horizontal drilling technology. **Background Photos:** Utah's early oil exploration drilling, development operations, pipeline construction, and Utah State Capitol. Used by permission, Utah State Historical Society, all rights reserved.

Message from the Governor

Utah is enjoying a period of exciting economic expansion and energy is a critical component to both maintaining and enhancing our growth opportunities. We are endowed with abundant natural resources that place Utah in a unique position to meet the energy needs of our Nation. Through the application of innovation and technology, we are poised to be a leader in America's sustainable energy future, fostering even greater economic vitality within our state and our country.

Utah's resources are not only abundant but diverse. Presently, more than 95% of the electricity produced in our state is coal-fired, largely fueled from local coal deposits. Our oil and gas production has ranked among the top 10-15 states in the nation for the past 40 years, with natural gas production rising spectacularly during the 1990s as coal bed methane gas has supplemented our conventional sources of production. Utah's rich oil shale and tar sands reserves are attracting the global attention of investors, innovators, and the general public. Moreover, Utah is attracting renewable resource development as investors seek to tap the benefits of the states' wind potential.



Jon M. Huntsman, Jr.

In addition to being energy-rich, Utah has managed to balance the preservation of its outstanding natural environment and quality of life. Our challenge will be to maintain this balance between promoting new resource developments and minimizing the environmental impacts. New technologies enable us to tap natural resources with reduced impact to the environment. For continued economic growth it is essential that we pursue both sustainable and efficient new energy developments, as well as conservation and prudent use of our energy supplies.

As Governor of this great state, I encourage exploration and development companies to consider including Utah in their portfolios. In addition to opportunities for applying new technologies to more efficiently extract oil from our known fields, Utah has many unexplored areas and the geological potential for concealed targets that contain oil and gas. There is also potential for significant expansion of our coalbed methane resources and development of our vast oil shale and tar sands reserves.

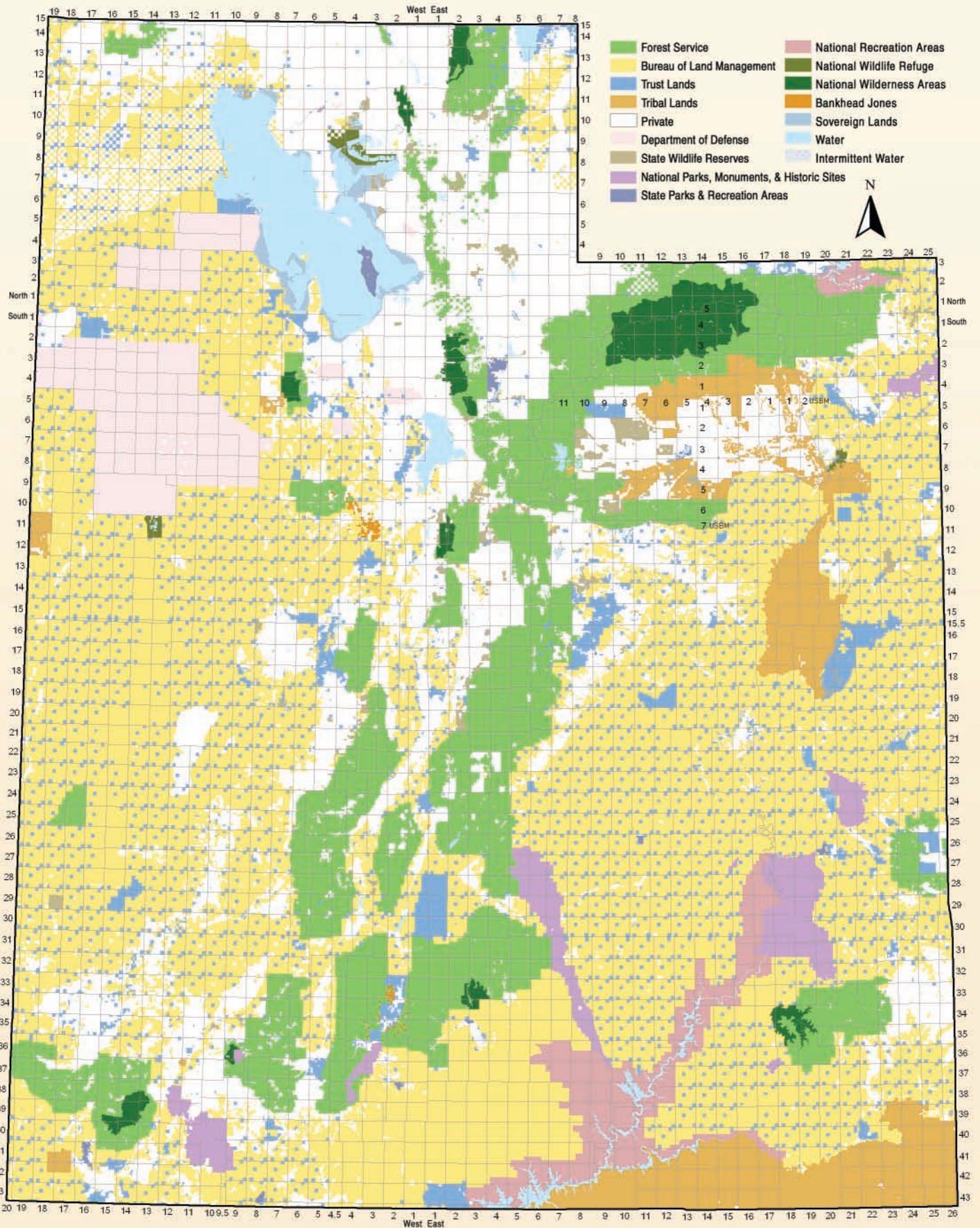
Several state agencies such as the Utah Geological Survey, the Division of Oil, Gas and Mining, the School and Institutional Trust Lands Administration and the Office of the Governor are ready to help with your queries regarding exploration and development opportunities. We have a supportive regulatory environment and a streamlined well-permitting process. I hope this brochure encourages you to invest in Utah's energy development during the coming years.

Welcome to Utah!

A handwritten signature in black ink that reads "Jon M. Huntsman, Jr." The signature is fluid and cursive, with a large initial "J" and "H".

Governor

Map of Land Ownership



SITLA: Leasing Environment

What is SITLA?

SITLA (School and Institutional Trust Lands Administration) is an independent state agency that manages 3.4 million acres of surface and 4.5 million acres of Utah mineral trust lands exclusively for the benefit of Utah's schools and other public institutions.

Out of the total oil and gas rights available on state trust land, there are currently about 1.5 million acres leased for oil and gas exploration and development. This means that there are approximately 3 million acres of trust land yet to be leased and evaluated for oil and gas potential.

Advantages of leasing from the Trust Lands Administration

- Fast and easy to commit lands to a lease or other business arrangement.
- Sealed-bid oil and gas lease offerings – January, April, July and October
Contact us to have your name placed on the bid mailing list, or visit our Internet site at www.trustlands.com and follow these links: Homepage>Minerals>Current Competitive Leasing, then select the offering or results of your choice.
- Over-the-counter leasing is available for some parcels. These parcels are leased on a first-come, first-serve basis, after being offered competitively.
Contact us or visit our Internet site at www.trustlands.com and follow these links: Homepage>Minerals>Over-the-Counter Leasing, to view current offerings.
- Not ONLY leasing options, but flexible business arrangement terms are also available for some parcels, such as
 - Exploration and development agreements
 - Drill to earn and farmouts
 - Seismic options
 - Other business arrangementsContact us for more information on these options.
- Timely state permitting process through the Division of Oil, Gas and Mining.



Pump jack - Ferron field

Give us a call, and let's consider the possibilities.

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You can download the ownership map on the preceding page or select other Utah maps from SITLA's Web site at www.trustlands.com. Follow these links: Homepage>Maps & GIS, then select a category from the left-hand navigation bar.

OGM: Utah's Regulatory Environment

The Oil and Gas Regulatory Program within the Division of Oil, Gas and Mining (OGM) regulates exploration for, and development of, oil and gas resources in Utah.

The Oil and Gas Regulatory Program incorporates important conservation principles derived from the historical exploitation of petroleum resources in the United States. It is our obligation to promote the wise development of oil and gas, preventing waste and maximizing ultimate recovery, while protecting the environment so that the public might realize the greatest possible good from these natural resources.

It is also our duty to protect correlative rights of all owners of oil and gas resources, controlling the proper participation and sharing of the various owners within an oil and gas pool.

OGM issues permits for all wells whether they are on private land, SITLA lands or the vast expanse of Federal (Bureau of Land Management, Tribal, or Forest Service) lands in Utah.

Through roughly 50 years of existence, the oil and gas conservation program has evolved into a user-friendly system for effective regulation of the state's oil and gas industry.

- **Permits** - The Division provides timely processing and approval of various permits involving drilling, workover and recompletion operations, underground injection, well plugging, and waste management.
- **Monitoring** - An experienced field staff monitors operations with regular inspections, enforcement, and database tracking of field operations.
- **Record Keeping and Public Information** - Basic well data, well histories, injection data, production reporting, operator statuses, and bonding are electronically stored and easily retrieved in our public information room or on our Web site.
- **Reporting Compliance** - An audit staff conducts reviews of industry compliance reports to ensure accurate and timely documentation.
- **Other Services** - Technicians provide expertise relating to tax credit qualification, royalty payment disputes, mapping, and abandoned well plugging.



Elk Petroleum "Nielsen 3-22," True rig 24, Pelican Lake in the background

Providing technically current, timely, and quality regulatory services –
The Utah Division of Oil, Gas and Mining.

Exploration History

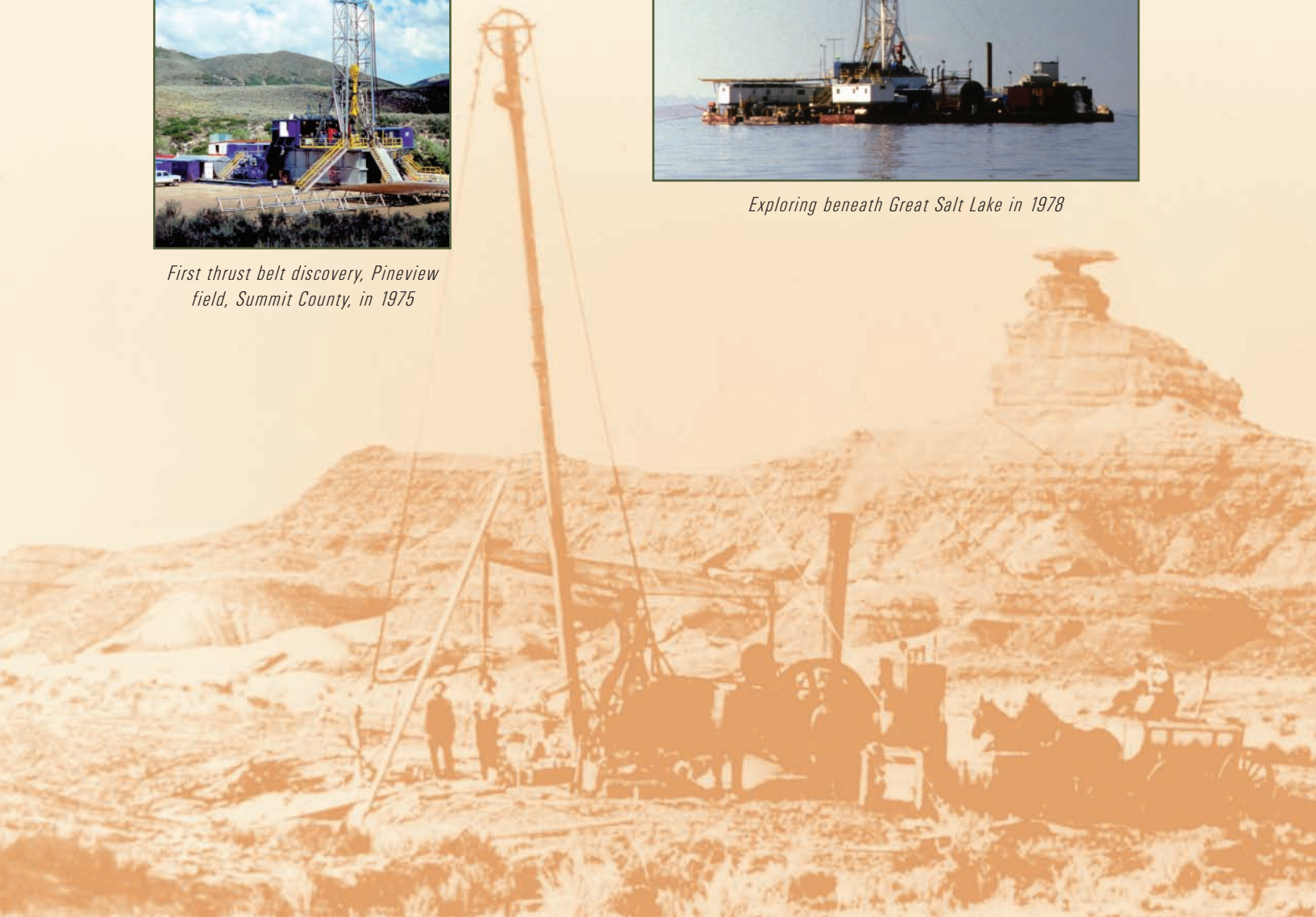
Utah's oil and gas exploration history extends back over 100 years. In 1891, natural gas was accidentally discovered at a depth of 1,000 feet in Farmington Bay on the eastern shore of Great Salt Lake during the drilling of a water well. Between 1895 and 1896, gas from several wells near this location was transported to Salt Lake City in a wooden pipe, marking Utah's first use of local oil or gas. The first oil shows were encountered in wells drilled during the early 1900s at Rozel Point (northern Great Salt Lake), Mexican Hat (near Monument Valley, southeastern Utah), and near the town of Virgin (near Zion National Park). Although oil shows were also found at several other eastern Utah locations in later decades, it was not until 1948 that Utah's first large-scale commercial oil well, Ashley Valley No. 1, was drilled near Vernal. By 1960, Utah was the 10th largest oil-producing state in the country, and it has remained in the top 15 since then. Today there are over 6,000 producing oil and gas wells.



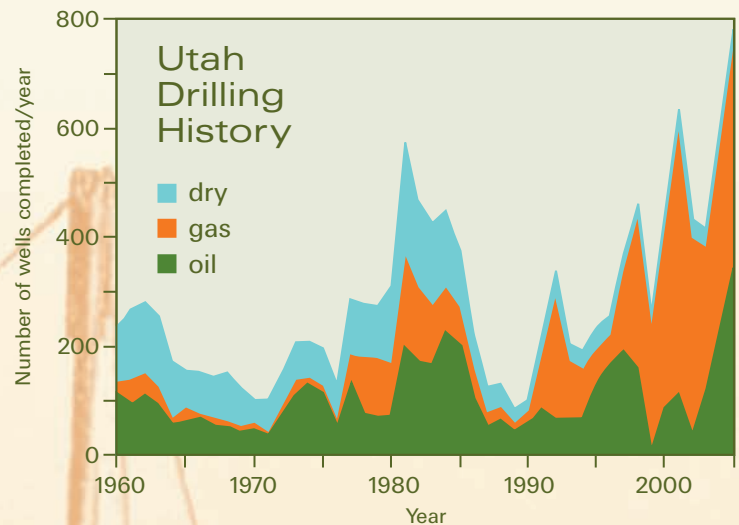
First thrust belt discovery, Pineview field, Summit County, in 1975



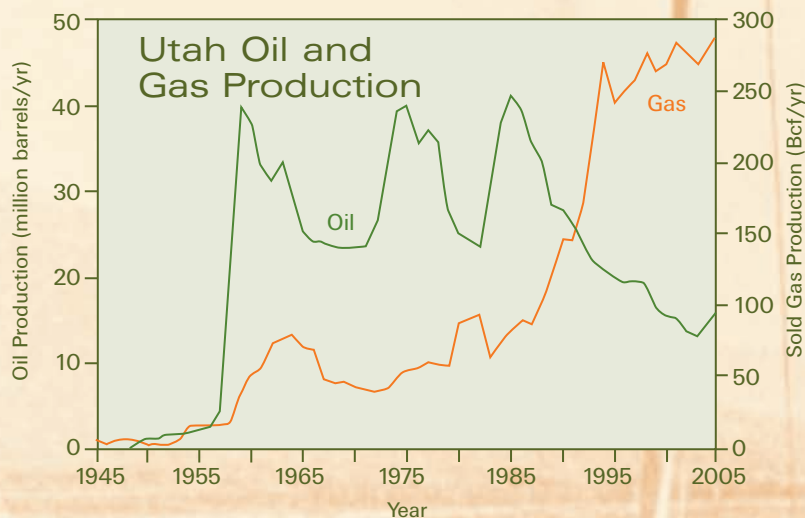
Exploring beneath Great Salt Lake in 1978



Utah's drilling history has fluctuated greatly due to discoveries, oil and gas price trends, and changing exploration targets. During the boom period of the early 1980s, activity peaked at over 500 wells per year. After slowing in the 1990s, drilling activity has again increased, reaching an all-time peak of 882 wells spudded in 2005. This increase in activity has been spurred by high prices for both oil and natural gas, and perceptions that Utah is highly prospective and under-explored. In recent years, the proportion of new wells exploring for gas has increased greatly. The success rate of exploration drilling for both oil and gas has also improved, with very few dry holes being reported compared to the 1980s drilling boom. Sustained high prices are likely to entice less risk-averse exploration investment (more wildcats), resulting in new discoveries.

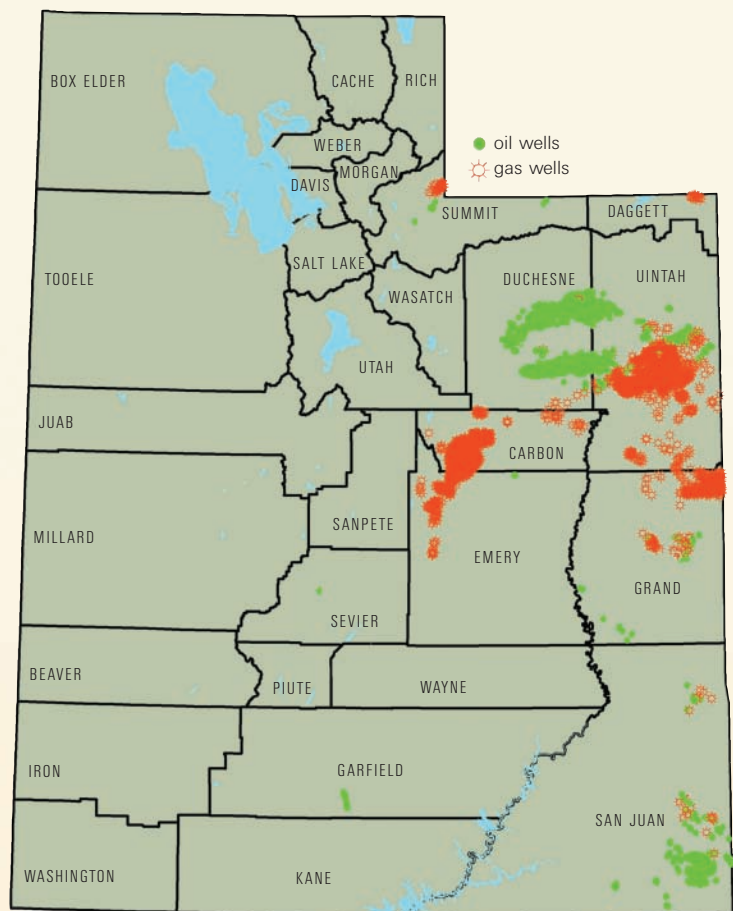


Utah oil fields have produced a total of 1.3 billion barrels (bbl). Although annual production decreased from a peak of 41 million bbl in 1985 to 13 million bbl in 2003, the trend has reversed and 2005 production reached 16 million bbl. A component of this turn-around has been the discovery of Covenant field in a new play known as the "Hingeline" or central Utah thrust belt. This new oil play is the focus of renewed exploration activity, and additional increases in production are expected. Despite over 40 years of production at rates that have varied by a factor of three, proven oil reserves during this time have remained between 200 and 250 million bbl, indicating significant oil remains to be produced.



Higher oil prices, horizontal drilling technology, more elaborate completion techniques, and secondary and tertiary recovery techniques should collectively result in a continued boost in production rates and ultimate recovery from both known fields and new discoveries. There is also resurgence in interest in Utah's substantial oil shale and tar sand resources, which received brief attention during the 1970s oil supply crisis.

Total natural gas production from Utah fields now exceeds 8 trillion cubic feet (Tcf), with sold production close to 6 Tcf. The difference in these two volumes is mainly due to reinjection of produced gas and nitrogen at Anschutz Ranch East field as part of a pressure maintenance program to prevent retrograde condensate loss. Total proven reserves of gas are close to 4 Tcf, and annual sold production is close to 0.3 Tcf. Recent successful drilling has been expanding reserves by about 10% per year, one of the highest rates of gas reserve increase in the country. Although gas production from some fields declined during the late 1990s, two factors caused overall gas production to increase. The development of coalbed methane accumulations in the Ferron play, in particular Drunkards Wash field, has added between 20 and 30% to the total annual gas production. Also, deeper exploration drilling in the eastern and southern Uinta Basin during the past five years has led to discoveries of substantial gas accumulations in Mesaverde, Entrada, and Wingate reservoirs. Significant potential exists for other coal fields around the Uinta Basin to yield coalbed methane, and the extent of deeper conventional and tight gas plays remains to be explored.



Producing oil and gas wells



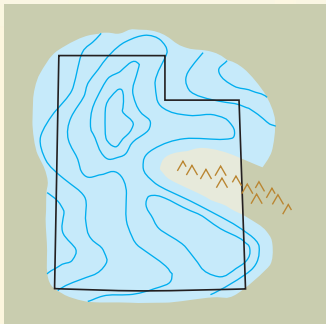
*Virgin oil field - Utah's first oil production
(only minor production realized)*

General Geologic Setting

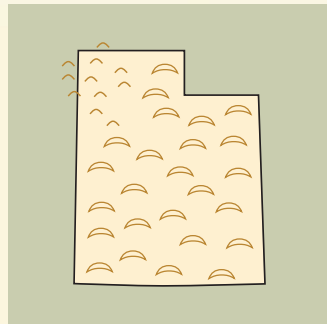
The ages of the rocks exposed in Utah include every geologic eon, era, period, and epoch. Many of these rocks have the qualities necessary to create the oil and gas reservoirs, sources, and seals that make Utah a petroleum-producing state with large, relatively unexplored areas of hydrocarbon potential. Because of Utah's world-class rock exposures, every producing formation and type of trap in the state can be examined in outcrop analogs. Many of these serve as outcrop analogs for oil and gas fields outside of Utah as well as providing a natural laboratory for study.

A combination of depositional and structural events created the major petroleum-producing provinces in Utah: Paradox Basin, Ferron coalbed methane fairway, thrust belt, Uncompahgre uplift, and Uinta Basin.

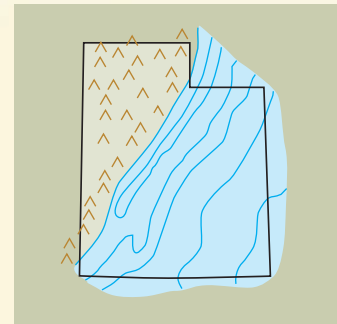
During the Pennsylvanian, the Paradox Basin developed in southeastern Utah where cyclic organic-rich shales, carbonates, and evaporites accumulated under restricted marine conditions in the rapidly subsiding basin. The Paradox Basin contains Utah's largest oil field, Greater Aneth. Renewed movement on deep, older basement faults in the basin formed structures productive in Mississippian-age carbonates.



Permian - Pennsylvanian
(240 - 330 mya)



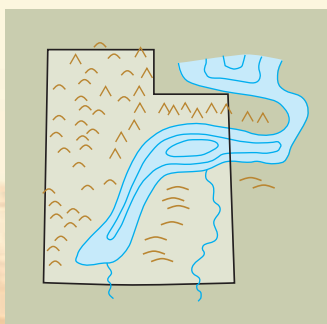
Early Jurassic
(187 - 205 mya)



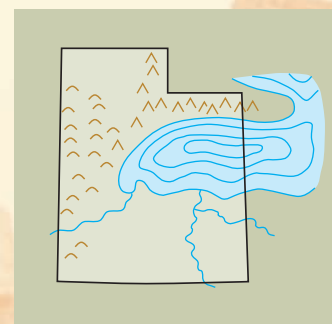
Cretaceous
(66 - 138 mya)

In Early Jurassic time, Utah had an arid climate and lay 15 degrees north of the equator. It was then that the most prolific reservoir in the thrust belt, the Nugget/Navajo Sandstone, was deposited in an extensive dune field comparable to the present Sahara. Correlative rocks form many of the spectacular canyons in the parks of southern Utah.

During the Cretaceous, compressional forces of the Sevier orogeny produced highlands in western Utah and the Western Interior Seaway covered most of eastern Utah. Extensive coal-forming swamps and marshes near the coastline (Emery, Book Cliffs, and Sego coal fields) and fluvial and wave-dominated deltas migrated eastward



Paleocene
(55 - 66 mya)

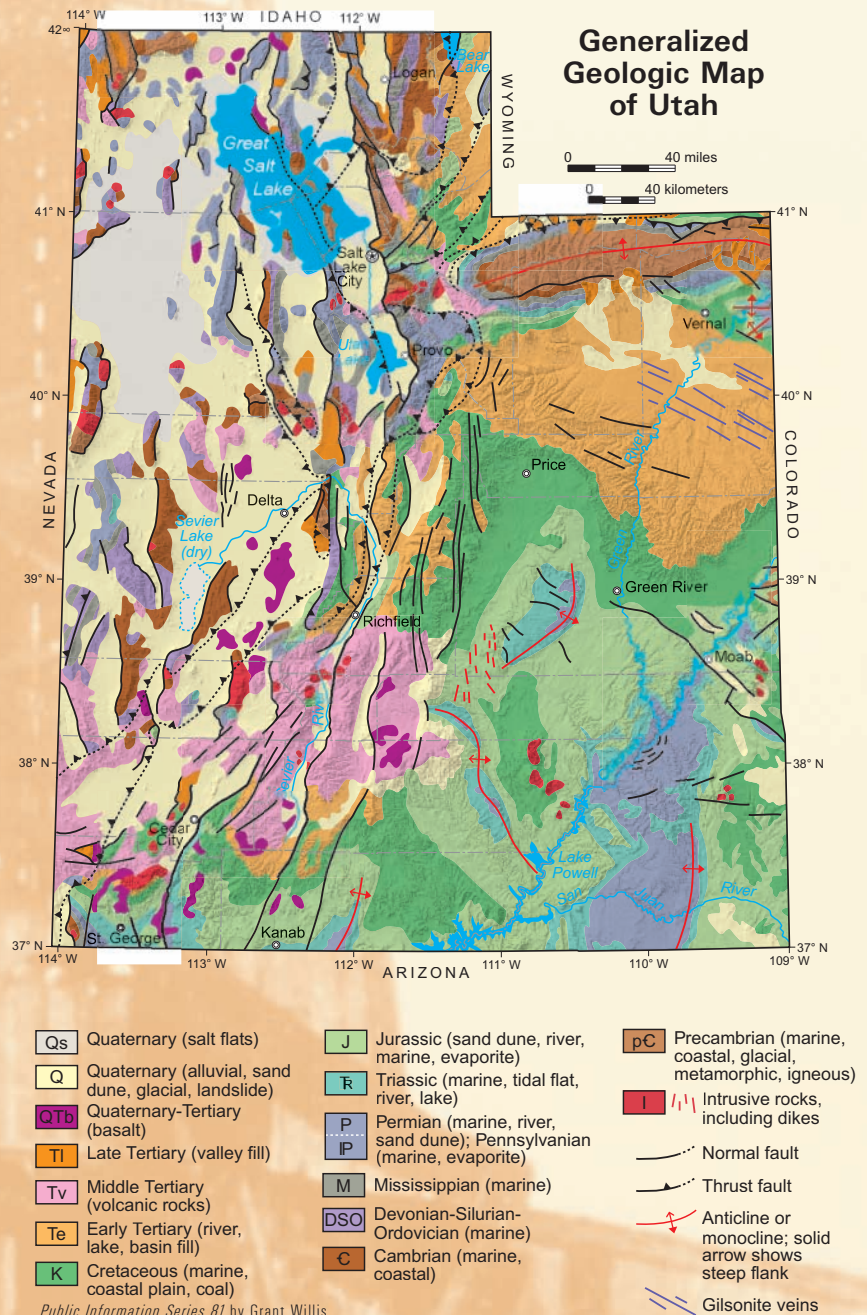


Eocene
(38 - 55 mya)

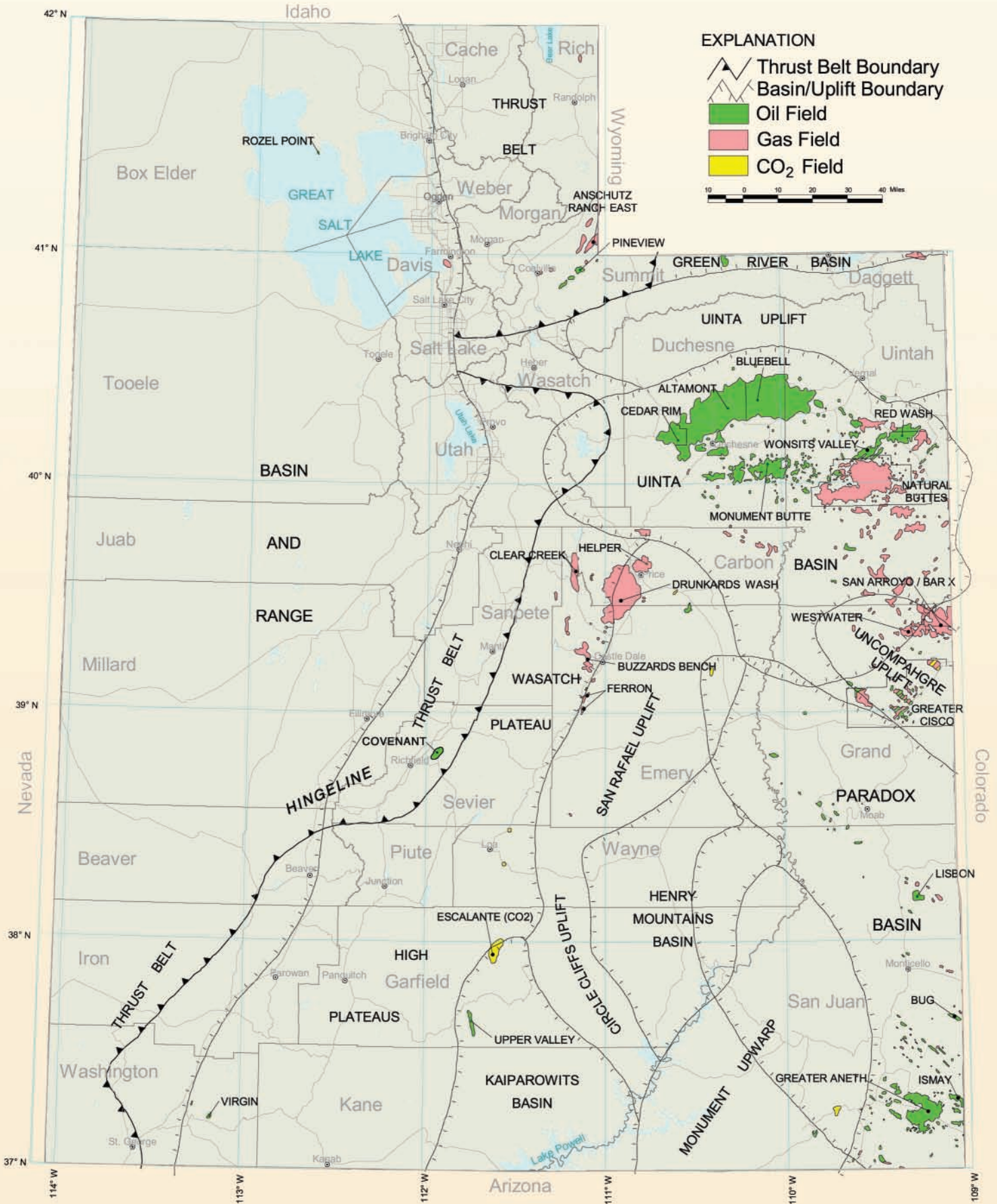
across the state as the sea eventually retreated. The resulting deposits are now the targets for gas production aggressively being pursued in eastern Utah and in the Ferron coalbed methane (CBM) fairway of central Utah. The Sevier orogeny continued into the Paleocene producing the "thin-skinned" folds and faults of the thrust belt that have been such prolific producers in northern Utah. Concealed, deep exploration targets beneath the Sevier thrusts offer frontier drilling opportunities in the poorly explored western half of Utah.

The Laramide orogeny, between latest Cretaceous and Eocene time, produced numerous basins and basement-cored uplifts in the Rocky Mountain states. In Utah, the Uinta Basin and Uncompahgre uplift are the major petroleum contributors. The northwest-trending Uncompahgre uplift represents a reactivation of ancient highlands of the Pennsylvanian-Permian Ancestral Rockies. Numerous subsidiary structures formed along the uplift and produce mainly gas. During the Paleocene and Eocene, lakes Flagstaff and Uinta formed in the Uinta Basin where over 11,000 feet of alluvial, marginal lacustrine (fluvial, deltaic, beach, etc.), and open lacustrine sediments accumulated in an inter-tonguing relationship. The eastern Uinta Basin is Utah's most prolific producer of non-associated (dry) gas; recent water-flood projects have been very successful in increasing oil production in the southern part of the basin.

The principal source rocks for these provinces were deposited during the Pennsylvanian, Permian, Cretaceous, and Tertiary as marine and lacustrine shale, and coal. The reservoir rocks were deposited in a variety of environments including deltas, shallow-shelf marine, eolian dunes, coastal-plain, and river-flood plain settings.

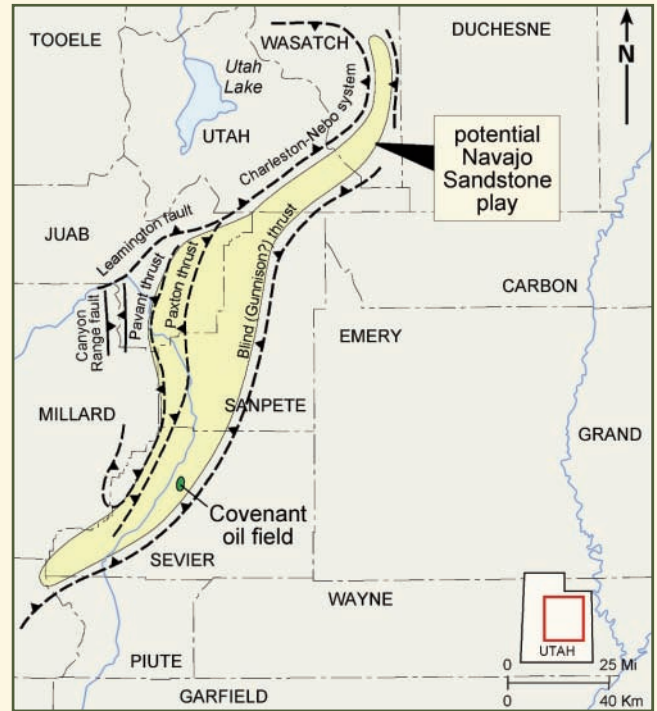


Utah's Oil and Gas Fields

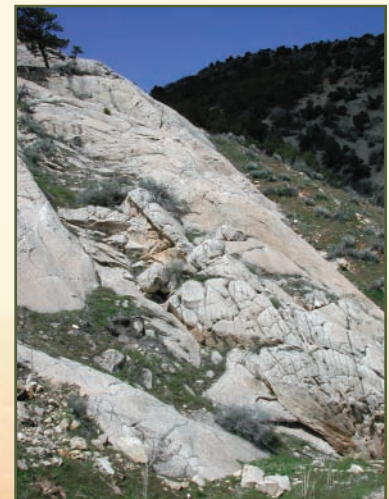


Hingeline

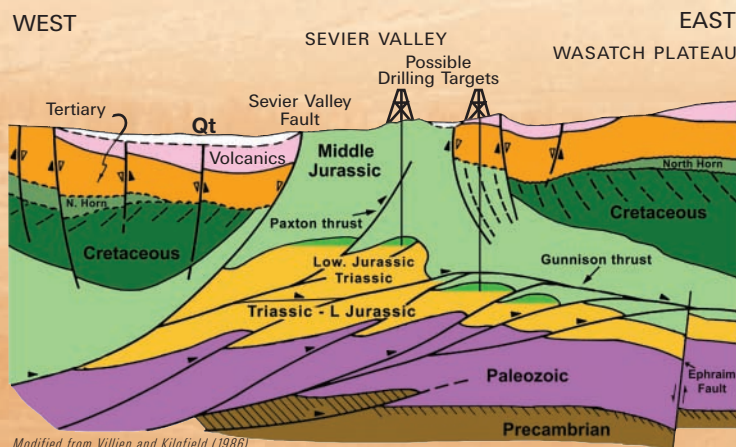
- Major reservoirs: Jurassic Navajo Sandstone, eolian dune sandstone.
- Trapping mechanisms: anticlines in the hanging walls of detached (not involving basement rocks) thrust systems created by thrust imbricates, or imbricate fans above, and antiformal stacks of horses forming duplexes below the major thrusts.
- Source rocks: organic-rich marine shale within the Mississippian Manning Canyon Shale, Delle Phosphatic Member of the Deseret Limestone, Doughnut Formation, or Chainman Shale; possibly Permian Park City/Phosphoria Formation.
- First commercial discovery: Covenant field, 2004.
- Number of active fields/wells: one field/seven wells.
- Average monthly production: 133,000 bbl of oil.
- Cumulative Production: 781,000 bbl of oil.
- Types of enhanced oil recovery projects: possible future carbon dioxide/nitrogen injection.
- Major pipelines: Questar Pipeline Co. (18", 24" gas), Questar Gas Co. (8" and 10" gas), Kern River Gas Transmission Co. (36" gas).
- Land ownership: 47% Private, 25% National Forest, 17% BLM, 11% School and Institutional Trust Lands Administration.
- Outcrop analogs in Utah: San Rafael Swell, Pavant Range, southern Wasatch Range, and throughout the Colorado Plateau of southern Utah.
- Utah Geological Survey contact: Thomas C. Chidsey, Jr., ph.: (801) 537-3364; e-mail: tomchidsey@utah.gov



Hingeline oil play area, central Utah (Covenant field shown in green)



Eolian dune sandstone, Jurassic Navajo Sandstone, southern Wasatch Range



Modified from Villien and Kilgfield (1986).

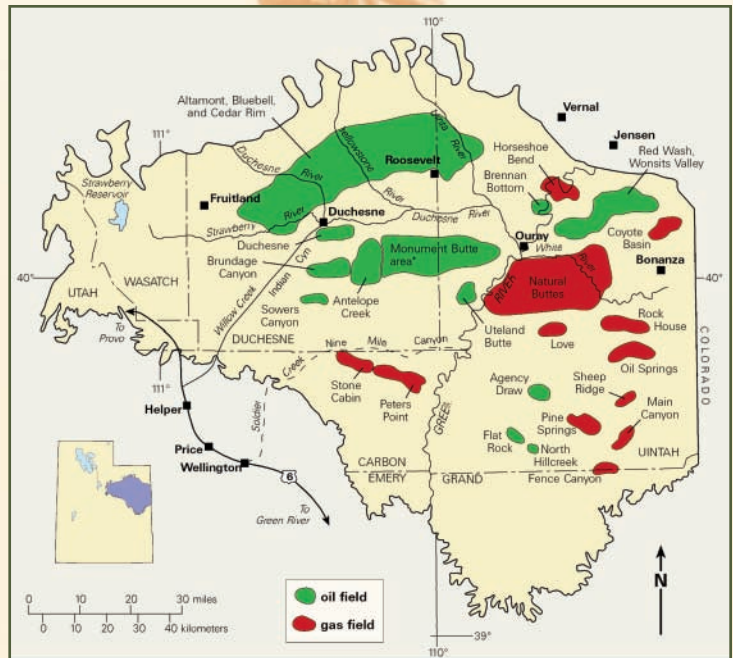
East-west structural cross section through Hingeline area

Uinta Basin

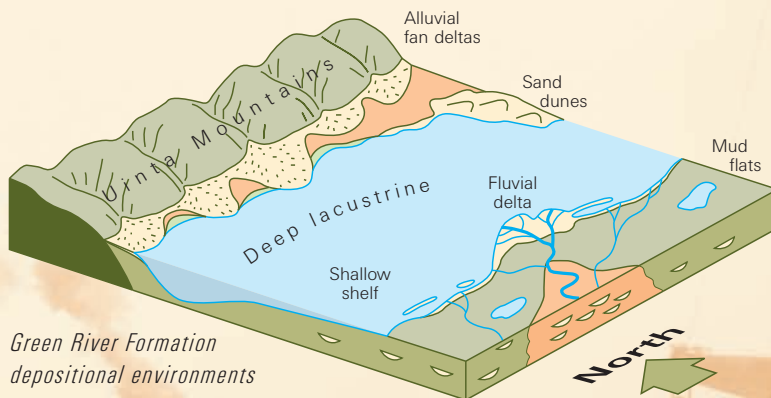
- Major reservoirs: Eocene Uinta, Green River, and Colton Formations, lacustrine to alluvial channel and bar sandstone; Cretaceous Mesaverde Group, fluvial and littoral sandstone; Jurassic Entrada and Wingate eolian sandstone; Permian Park City Formation, shallow marine limestone and dolomite; and Pennsylvanian Weber Sandstone, coastal eolian and littoral sandstone.
- Trapping mechanisms: anticlinal at Ashley and Peters Point fields, stratigraphic conventional and basin centered.
- Source rocks: Cretaceous coals and shale, Eocene lacustrine shale.
- First commercial discovery: gas at the Ashley Valley field, 1925, and oil at Roosevelt field, 1949.



Red Wash field, Uintah County



Uinta Basin fields



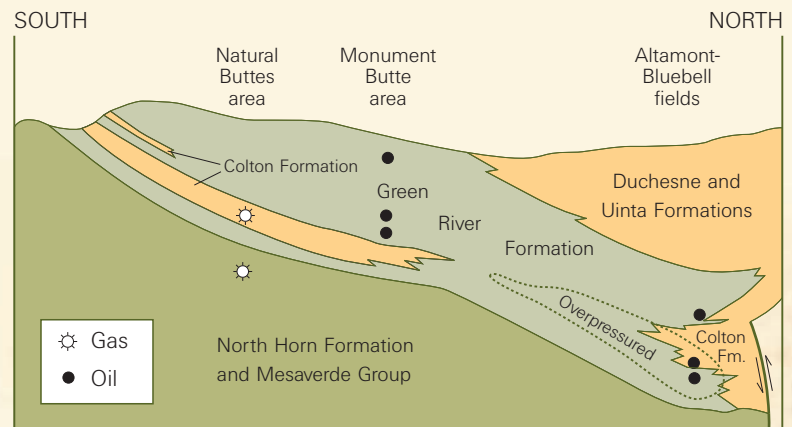
Green River Formation depositional environments

Sandstone and grainstone	Red shale / silt
Green shale / silt	Carbonate mudstone / black shale

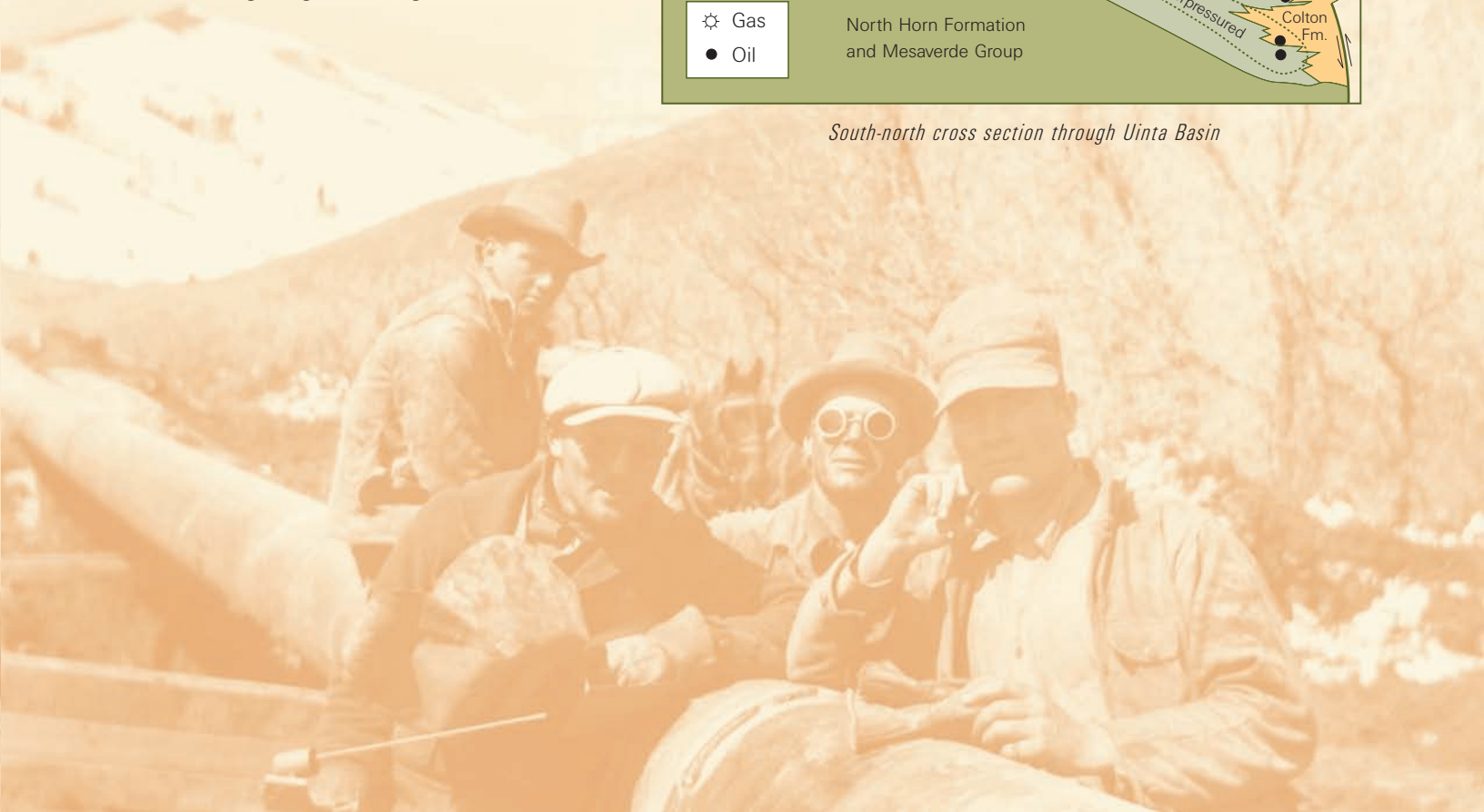
- Number of active fields/wells: 51 fields/ 5,279 wells.
- Recent monthly production: 926,869 bbl of oil, 16 billion cubic feet (Bcf) of gas.
- Cumulative production: 528 million bbl of oil, 2.6 Tcf of gas.
- Types of enhanced oil recovery projects: water-flood in the Green River Formation.
- Major pipelines: Chevron Pipeline Co. (10" oil [2 lines]), Colorado Interstate Gas Co. (20" gas), Enterprise Products Partners (10" and 16" products), Questar Pipeline Co. (16" and 20" gas) Williams Gas Pipeline - Northwest (26" gas).
- Land ownership: 80% BLM, 7% National Forest, 6% Native American, 5% Private, 1% SITLA.
- Outcrop analogs in Utah: Book, Roan, and Badlands Cliffs, and Raven Ridge.
- Utah Geological Survey contact: Craig D. Morgan, ph.: (801) 537-3370; e-mail: craigmorgan@utah.gov



Cretaceous Mesaverde Group in the Book Cliffs north of Floy, Grand County, Utah



South-north cross section through Uinta Basin

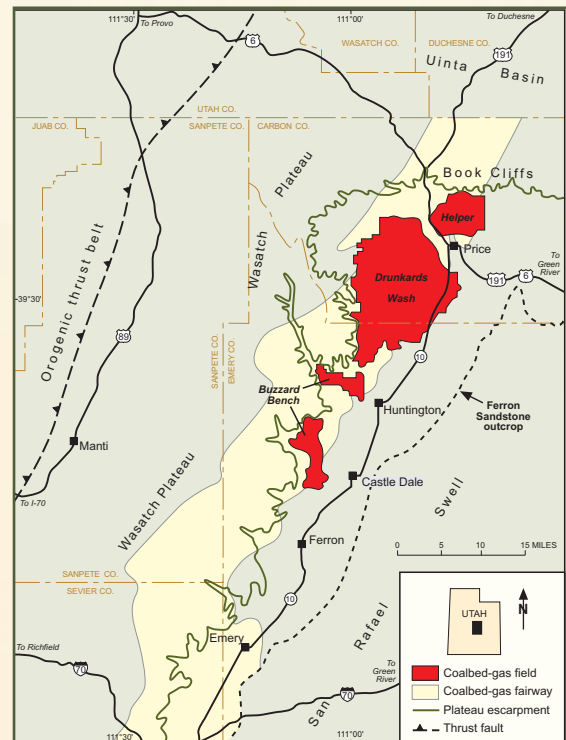


Coalbed Methane (CBM) Plays

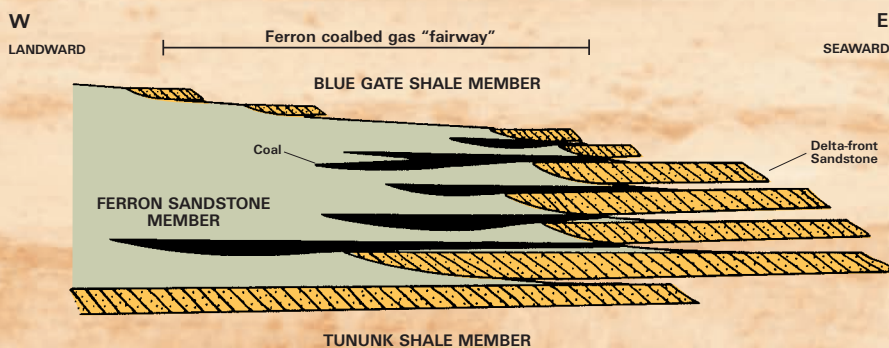
- Major reservoirs: primarily coal, with some organic shale and sandstone beds in the Ferron Sandstone Member of the Mancos Shale, and the Blackhawk Formation.
- Trapping mechanisms: self-sourcing reservoir beds with some secondary biogenic gas and some migrated gas trapped by updip stratigraphic pinchout of reservoir beds.
- Source rocks: coal and organic shale beds in the Ferron Sandstone Member of the Mancos Shale, and the Blackhawk Formation.
- First commercial discovery: Drunkards Wash field, 1992 (Ferron); Castlegate field, 1993 (Blackhawk).
- Number of active fields/wells: 5 fields/ 841 wells.
- Recent monthly production: 0 bbl of oil, 7.0 Bcf of gas.
- Cumulative production: 0 million bbl of oil, 0.7 Tcf of gas.



The thick basal marine sandstone and the overlying shales, sandstones, and coals of the Ferron Sandstone as exposed near Emery, Utah

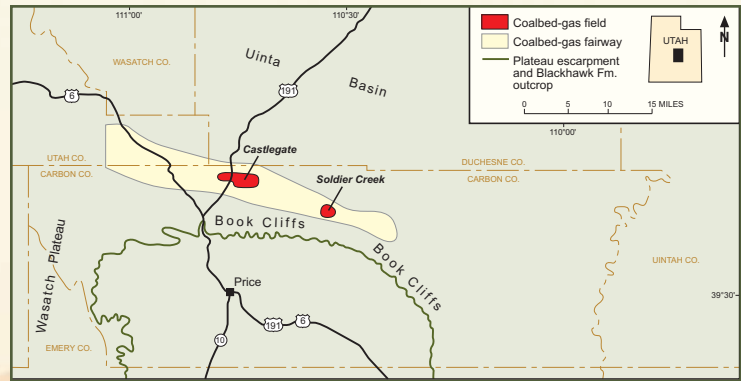


Trend of thick net coal and fields in the Ferron Sandstone CBM play



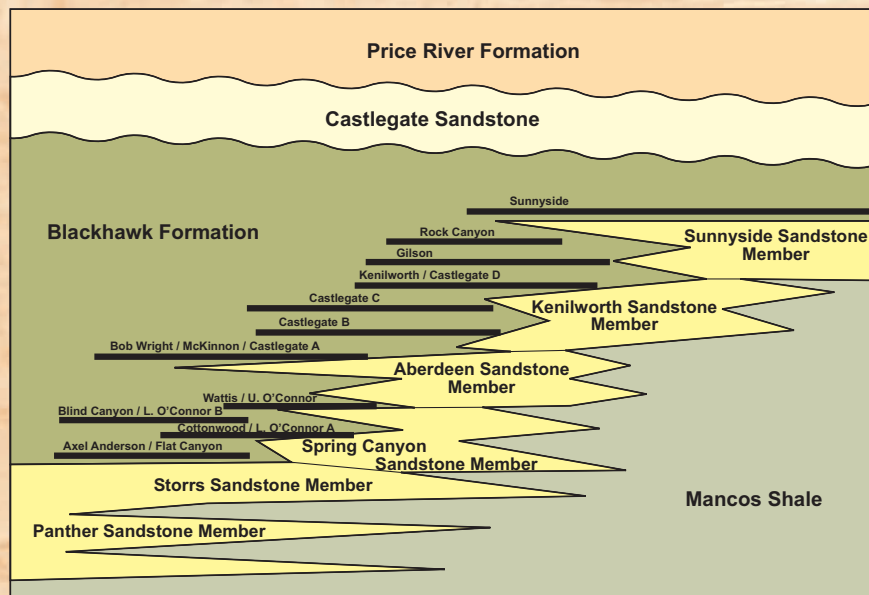
West-east cross section across the Ferron Sandstone CBM play

- Types of enhanced oil recovery: none at present.
- Major pipelines: Questar Pipeline Co. (6" and 20" gas), Conoco Phillips Co. (10" gas).
- Ferron land ownership: 48% National Forest, 26% Private, 16% BLM, 8% SITLA, 1.2% State Wildlife Resources, <0.1% State Park.
- Blackhawk land ownership: 78% Private, 13% BLM, 9% SITLA.
- Outcrop analogs in Utah: exposures of the Ferron Sandstone Member of the Mancos Shale along the western flank of the San Rafael Swell to the south-east of Emery, Utah, exposures of the Blackhawk Formation along the Book Cliffs.



Trend of thick net coal and fields in the Blackhawk Formation CBM play

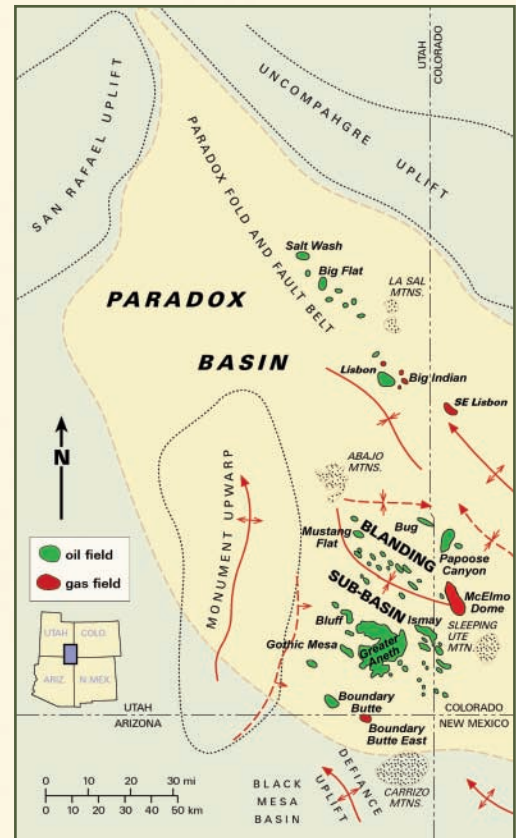
- Utah Geological Survey contact: David E. Tabet, ph.: (801) 537-3373; e-mail: davidtabet@utah.gov



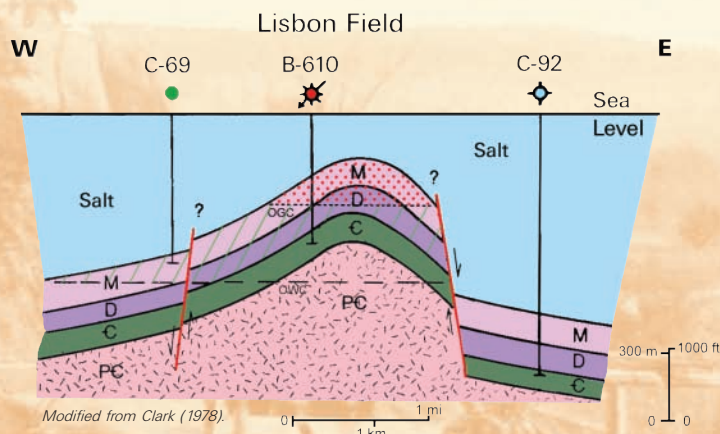
West-east cross section across the Blackhawk Formation CBM play

Paradox Basin

- Major reservoirs: Devonian McCracken Sandstone Member of the Elbert Formation, subtidal to supratidal dolomite to delta-front sandstone; Mississippian Leadville Limestone, shallow-shelf marine limestone and dolomite; Pennsylvanian Paradox Formation, shallow-shelf marine limestone and dolomite in the Desert Creek and Ismay zones, and fractured units in the Cane Creek shale; Pennsylvanian Honaker Trail Formation, beach and deltaic sandstone; Permian Coconino Sandstone, eolian sandstone.
- Trapping mechanisms: stratigraphic – carbonate buildups (algal mounds, shoals, islands) sealed by anhydrite, salt, or organic-rich shale; structural – fracture zones faulted and asymmetrical anticlines; diagenetic – dolomitization and dissolution.
- Source rocks: black, organic-rich marine shale within the Pennsylvanian Paradox Formation.
- First commercial discovery: Boundary Butte field, 1947.
- Number of active fields/wells: 78 fields/779 wells.
- Average monthly production: 344,000 bbl of oil, 1.1 Bcf of gas.
- Cumulative production: 548 million bbl of oil, 1.4 Tcf of gas.
- Types of enhanced oil recovery projects: waterflood, CO₂ flood (CO₂ provided by pipeline from McElmo Dome in Colorado or locally from the Mississippian Leadville Limestone within the Utah part of the Paradox Basin), gas injection, horizontal drilling.



Paradox Basin fields

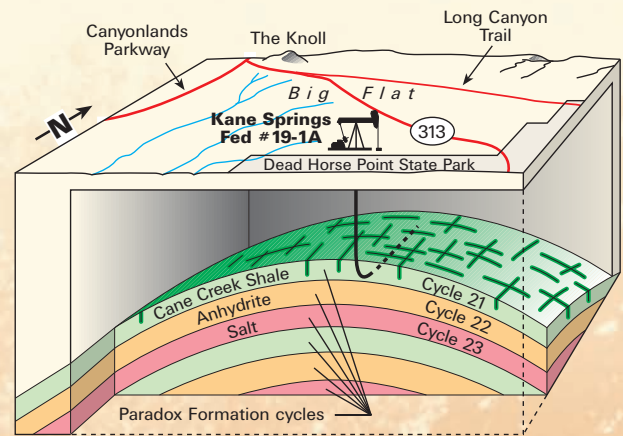


West-east structural cross section through Lisbon field that produces from the Leadville Limestone

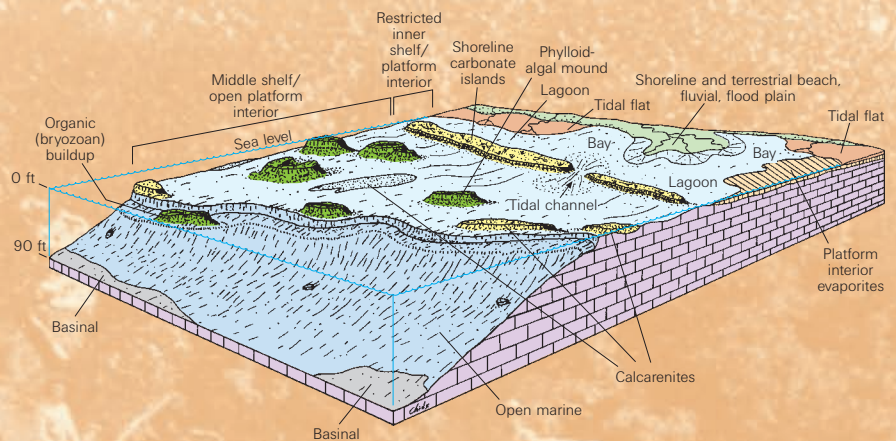


Paradox Formation algal mound, San Juan River Canyon

- Major pipelines: Four Corners Pipeline Co. (12" oil), Navajo Nation Oil and Gas Co. (16" oil), Encana (10" oil), TransColorado Pipeline Gathering Co. (4" gas), Utah Gas Services Co. (4" gas), Western Gas Resources, Inc. (16" gas), Williams Gas Pipeline - Northwest (26" gas), ExxonMobil/Resolute Natural Resources/Navajo Nation Oil and Gas Co. (8" carbon dioxide), Enterprise Products Partners LP (10" products).
- Land ownership: 56% BLM, 11% National Park, 9% Native American, 8% School and Institutional Trust Lands Administration, 8% Private, 7% National Forest, 1% Wilderness.
- Outcrop analogs in Utah: shallow-shelf carbonates and karst features, Mississippian Madison and Deseret Limestones, south flank of the Uinta Mountains; Ismay and Desert Creek algal mounds, Pennsylvanian Paradox Formation, exposed along the San Juan River in southeastern Utah; deltaic and eolian sandstone, Pennsylvanian Honaker Trail Formation and Permian White Rim Sandstone, respectively, Canyonlands area.
- Utah Geological Survey contact: Thomas C. Chidsey, Jr., ph.: (801) 537-3364; e-mail: tomchidsey@utah.gov



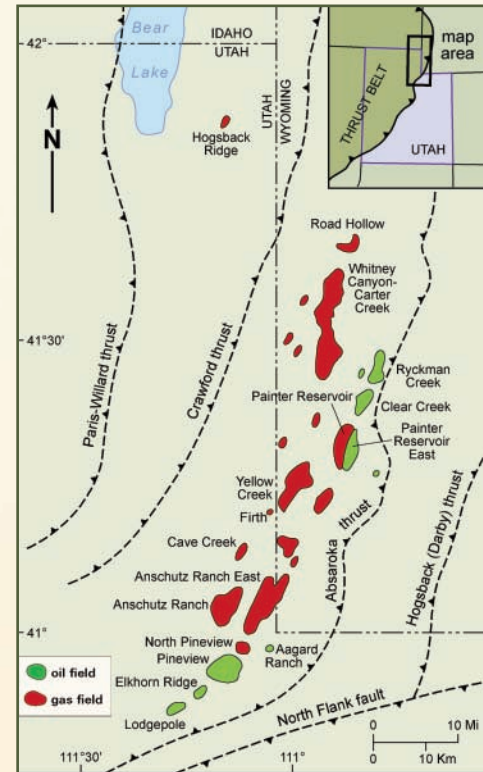
Schematic of horizontal drilling targets, Cane Creek shale, Park Road field



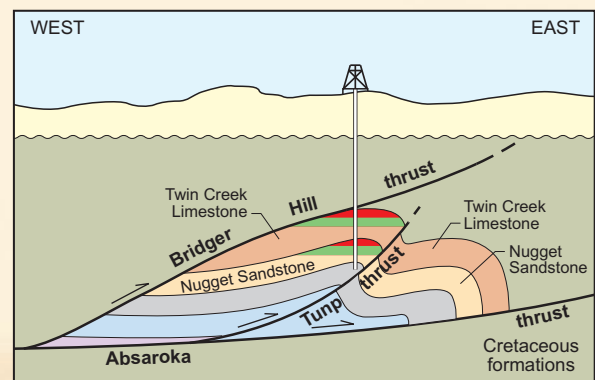
Pennsylvanian Paradox Formation depositional environments

Thrust Belt

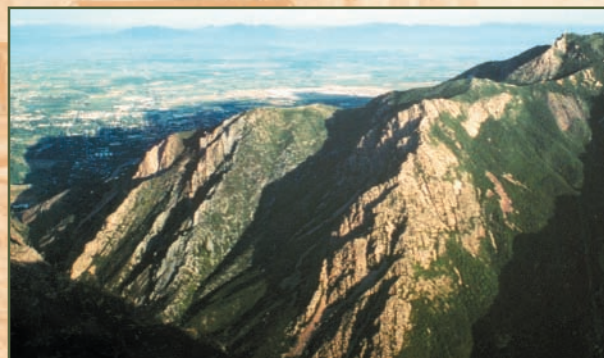
- Major reservoirs: Mississippian Madison Group, open-marine to supratidal limestone and dolomite; Pennsylvanian Weber Sandstone, coastal eolian and littoral sandstone; Permian Phosphoria Formation, shallow marine limestone, dolomite, phosphatic shale, and chert; Triassic Dinwoody Formation, tidal-flat dolomite; Jurassic Nugget Sandstone, eolian dune sandstone; Jurassic Twin Creek Limestone, shallow marine limestone.
- Trapping mechanisms: anticlines in the hanging walls of detached (not involving basement rocks) thrust systems, and untested subthrust structures (beneath detached and basement-cored faults).
- Source rocks: Cretaceous Mowry Shale; possibly Permian Phosphoria Formation.
- First commercial discovery: Pineview field, 1975.
- Number of active fields/wells: 10 fields/79 wells.
- Average monthly production: 34,300 bbl of oil, 1.3 Bcf of gas.
- Cumulative production: 166 million bbl of oil, 3.1 Tcf of gas.
- Types of enhanced oil recovery projects: gas re-injection to maintain pressure, horizontal drilling.
- Major pipelines: Pacific Energy Partners LP (8" oil), Rocky Mountain Pipeline Systems LLC (10", 16" oil), Chevron Pipeline Co. (10" oil), Pioneer Pipeline Co. (8" products), Enterprise Products Partners LP (6" products), Questar Pipeline Co. (10", 12", 16", 18", 20", 24", gas), Kern River Gas Transmission Co. (36" gas), Williams Gas Pipeline - Northwest (22" gas), Anadarko Rocky Mountain Energy (10" hydrogen sulfide).
- Land ownership: 71% Private, 16% National Forest, 6% BLM, 3% School and Institutional Trust Lands Administration, 3% Wilderness, 2% Utah Division of Wildlife Resources.
- Outcrop analogs in Utah: northern Wasatch Range, Crawford Mountains.
- Utah Geological Survey contact: Thomas C. Chidsey, Jr., ph.: (801) 537-3364; e-mail: tomchidsey@utah.gov



Thrust belt fields



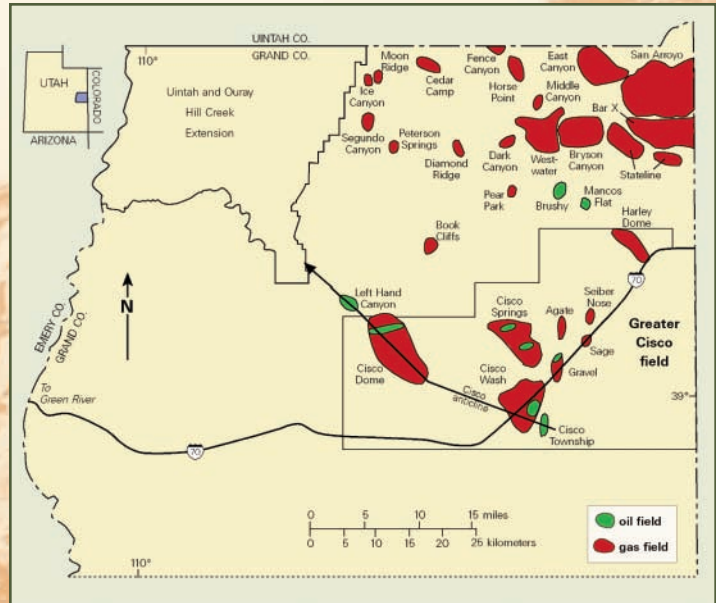
West-east structural cross section



*East-dipping Ogden thrust,
Ogden Canyon*

Uncompahgre Uplift

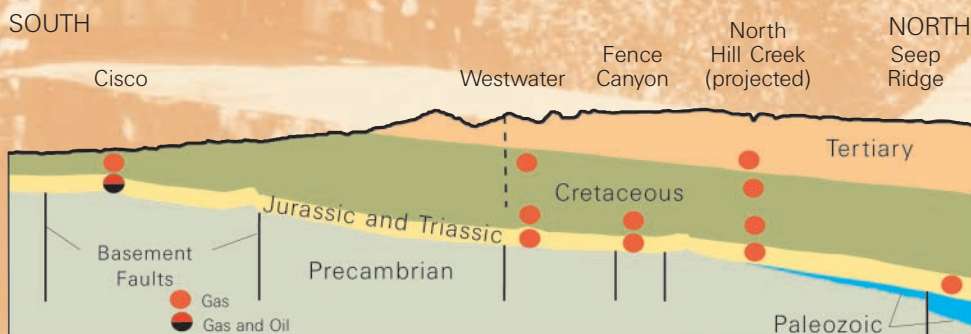
- Major reservoirs: Cretaceous Dakota and Cedar Mountain Formations, fluvial and littoral sandstone; Jurassic Morrison Formation, fluvial sandstone; and Jurassic Entrada and Wingate, eolian sandstone.
- Trapping mechanisms: combination structural and stratigraphic.
- Source rocks: Cretaceous shale and possibly Permian and Pennsylvanian shale.
- First commercial discovery: Cisco Dome field, 1925.
- Number of active fields/wells: 21 fields/541 wells.
- Recent monthly production: 1,799 bbl of oil, 0.5 Bcf of gas.
- Cumulative production: 2.9 million bbl of oil, 0.3 Tcf of gas.
- Types of enhanced oil recovery projects: one waterflood unit (Calf Canyon) in the Cedar Mountain Formation.
- Major pipelines: Williams Gas Pipeline - Northwest (26" gas), Enterprise Products Partners (10" products).
- Land ownership: 98% BLM, 1.6% Native American, 0.6% SITLA.
- Outcrop analogs in Utah: Cretaceous and Jurassic outcrops south of the production area.
- Utah Geological Survey contact: Craig D. Morgan, ph.: (801) 537- 3370; e-mail: craigmorgan@utah.gov



Uncompahgre uplift fields



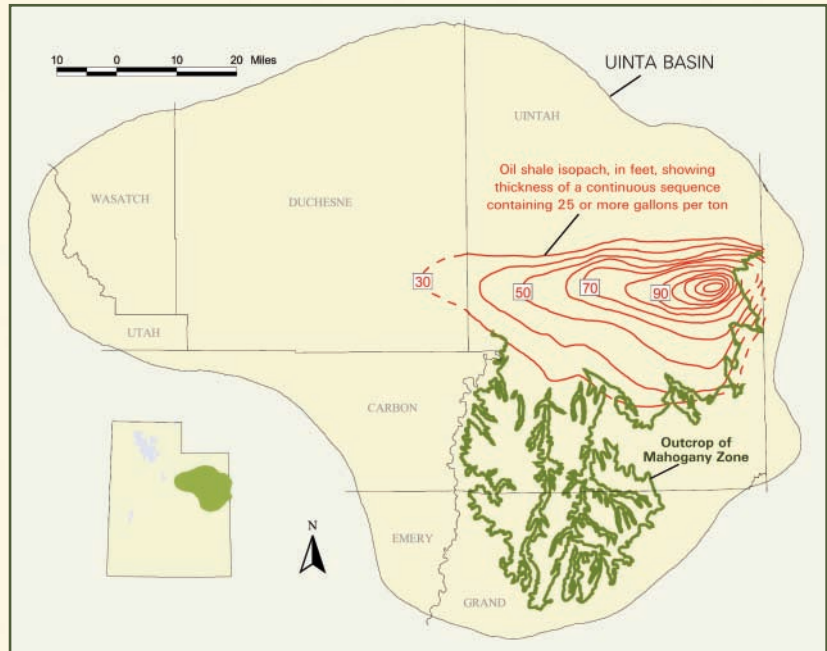
Wingate Sandstone, Seven Mile Canyon in Grand County



South-north cross section across the Uncompahgre Uplift

Oil Shale

- The largest oil shale deposits in the world are in the Eocene Green River Formation, which covers parts of Utah, Colorado, and Wyoming. Utah's oil shale deposits are found in the northeast corner of the state within the Uinta Basin.
- Organic and lime-rich mud deposited in a large lake about 50 million years ago forms the present-day oil shale.
- The organic material preserved in the oil shale is not oil, but a substance called kerogen that can be heated either at the surface or underground to produce crude oil and natural gas.
- The stratigraphic section with the richest oil shale is the Mahogany zone, which in Utah can contain more than 40 bbl of oil per ton of shale and can be up to 130 feet thick.
- Estimates of the in-ground oil resource contained within Utah oil shale are over 300 billion bbl, based on oil shale at a grade of greater than 15 gallons per ton. Potential reserves based on 30 gallons per ton and a thickness of 15 feet are almost 20 billion bbl of oil.
- The Utah Geological Survey is compiling an oil shale information database for the UGS Web site. This database will contain copies of previously published and unpublished reports and digital resource information.
- Utah Geological Survey contact:
Michael D. Vanden Berg, ph.: (801) 538-5419;
email: michaelvandenber@utah.gov



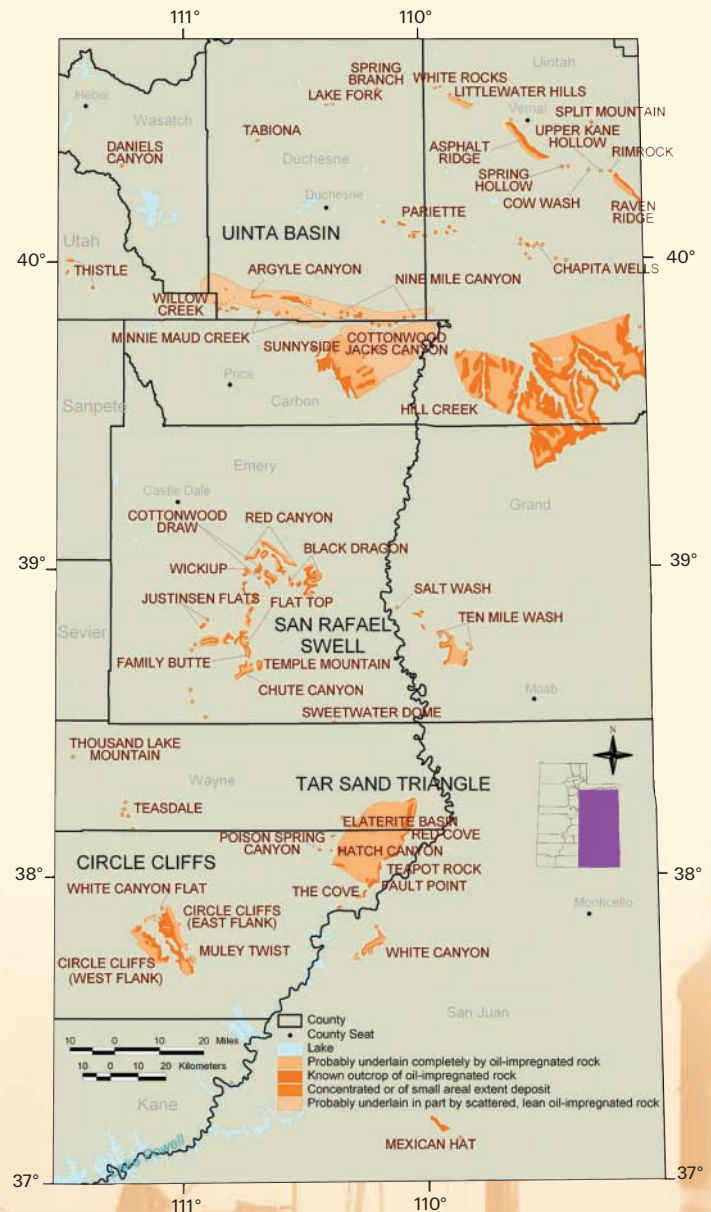
Location of oil shale deposits in Utah



Oil shale sample showing bands of kerogen

Tar Sand Resources of Utah

- Utah's tar sand resources are the largest in the United States. Other states having tar sand resources include Alabama, Alaska, California, Kentucky, New Mexico, Oklahoma, Texas, and Wyoming.
- The Uinta Basin hosts the majority of Utah's tar sands, both in terms of the number of deposits and resources-in-place (measured and estimated). Other deposits are present in the Tar Sand Triangle, Circle Cliffs, and the San Rafael Swell areas.
- Utah's measured tar sand resource is at least 12 billion bbl oil-in-place. The total estimated resource includes an additional 7 billion bbl.
- The average bitumen content of Utah's tar sands ranges from 4.5% to 14.1%, average API gravity from -3 to 12, sulfur content (wt%) from 0.3 to 3.8, carbon content from 13% to 24%, and atomic hydrogen/carbon ratio from 1.31 to 1.65.
- Despite the failure of numerous past efforts to develop this heavy-oil resource, the current period of sustained high oil prices is stimulating a resurgence in interest.
- Advances in oil extraction from tar sands in other countries such as Canada make the vast Utah deposits an attractive target. The results and strategies used in bitumen extraction and oil upgrading, developed by industry and academia, are readily available and will provide a solid foundation for the development of Utah's tar sand resources in the future.
- Utah Geological Survey contact: Wally Gwynn, ph.: (801) 537-3366; e-mail: wallygwynn@utah.gov



Tar sand deposits



Main Canyon tar seep in the P.R. Spring area

Utah Core Research Center

- The Utah Core Research Center (UCRC) occupies a 12,000-square-foot warehouse managed by the Utah Geological Survey, and contains the region's only publicly available and most complete collection of geologic cuttings and core from Utah.
- Holdings include cuttings from >3500 wells, cores from >700 wells, samples from major tar sands and oil shale deposits, and type oils from all producing formations in the state. The holdings catalogue is Web-accessible.
- The UCRC is available for industry and academic research, workshops, and short courses.
- Samples may be examined on-site, or borrowed for up to six months; destructive testing may be allowed with advance permission.
- Highlights of the core collection include the fluvial-dominated deltaic rocks of the Ferron Sandstone of east-central Utah, and the shallow-shelf carbonates of the Pennsylvanian Paradox Formation of southeastern Utah.
- Utah Geological Survey contact: Michael Laine, ph.: (801) 537-3359; e-mail: michaellaine@utah.gov



Sources of Utah Oil and Gas Information

- Production, consumption, reserves and price trends for all energy commodities:
<http://geology.utah.gov/sep/newdata/statpage.htm>
- Oil and gas resources, Utah oil and gas map, research reports:
<http://geology.utah.gov/utahgeo/energy/oilgas/index.htm>
- Oil and gas well locator map:
<http://atlas.utah.gov/oilgaswells2/viewer.htm>
- Oil and gas well logs:
http://www.ogm.utah.gov/oilgas/DATA_SEARCH/well_data_search.htm
- Catalogue of oil and gas well cores and cuttings:
<http://geology.utah.gov/emp/ucrc/index.html>
- Production data:
http://ogm.utah.gov/oilgas/PUBLICATIONS/Reports/report_list.htm
- Data on permits, drilling starts, completion reports:
<http://ogm.utah.gov/oilgas/STATISTICS/statindx.htm>



Utah Geological Survey



**School and Institutional
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Division of Oil, Gas and Mining



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